DOCUMENT RESUME

ED 298 925 IR 013 310

AUTHOR Platt, William A.; Andrews, Dee H.
TITLE Educational Technology in Military Training Applications: A Current Assessment.
PUB DATE 84
NOTE 14p.; In: Instructional Development: The State of the Art, II; see IR 013 273. For volume I, see ED 292 444.
PUB TYPE Historical Materials (060) -- Viewpoints (120) -- Reports - Descriptive (141)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Educational Technology; *Instructional Development; *Military Training; Models; Program Evaluation; *Simulation; Systems Approach; *Training Methods
IDENTIFIERS *Department of Defense; *Navy

ABSTRACT

This chapter considers the history of instructional development (ID) in the military, with particular emphasis on the U.S. Navy. The ID process used at the Navy's Instructional Program Development Centers is presented, including the process for simulator development. An in-depth analysis of the problems encountered with educational technology applications in the military focuses on the following: (1) failure to integrate the ID process with the DoD (Department of Defense) budgetary process; (2) failure to fully analyze the task and learning environment; (3) substitution of trivial objectives for more meaningful, but difficult-to-measure, objectives; (4) failure to consider the need for effective motivation; (5) failure to provide a detailed strategy for instruction; (6) failure to identify and resolve evaluation problems; and (7) failure to make full use of the iterative status of instructional development. Future trends in the Naval instructional systems development process are identified, and recommendations are made for changes in the system as well as in the training of instructional development graduate students. One figure is included. (43 references) (Author/EW)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
This document has been reproduced as received from the person or organization originating it.
Minor changes have been made to improve reproduction quality.
Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

ED298925

B. MILITARY

Chapter 37

Educational Technology in Military Training Applications: A Current Assessment

William A. Platt
Dee H. Andrews

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Charles Dills
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Many developers work for the military, and many more projects contracted for by civilian companies. It is likely that in the future, the manpower base for the military ID effort will be greatly expanded.

Further, many of the most sophisticated developments in educational technology are occuring in the military. And many of the best examples of what not to do in ID are to be found in the military.

For these reasons, all developers can benefit from a greater understanding of ID in the military. The present chapter discusses the history, the present status, outstanding accomplishments, problems, and the future, of ID in the military.

INTRODUCTION AND BACKGROUND

The Department of Defense (DOD) now spends more than seven billion dollars annually on training and educational opportunities. Fifteen to twenty percent of the three million military and civilian personnel in the DOD are normally involved in training programs at any one time (Rose, 1976). Given this tremendous expenditure of resources, and the defense responsibility which the DOD bears, it has become imperative that the military define and overcome the training challenges which it faces.

IR013310

The authors wish to express their appreciation to Charles A. Beagles for review of this chapter. The opinions and viewpoints expressed in this chapter are those of the authors and do not necessarily represent those of the Department of Defense.

The achievement of an effective national defense is generally accepted as being a worthwhile goal. However, developing the means for training the forces necessary to operate sophisticated weapons systems has caused much frustration and has resulted in considerable controversy. It is clear that technical-specialty training has emerged as a significant challenge to the Department of Defense (Ebel, Noll & Bauer, 1969).

A variety of factors have contributed to military training difficulties. Among them are a decrease in reading skills (Duffy & Nugent, 1978; GAO, 1977), persistent motivation problems (Naval Technical Training Command, 1977), high personnel turnover (Dougherty & O'Neill, 1978), and a large increase in the technical sophistication of weapons and communication systems. The complexity of modern weapon systems requires not only higher levels of competence on the part of operators, but also a vast technical-support establishment concerned with system maintenance. An integral part of both operational and maintenance readiness is the training sub-system.

It is possible to both praise and criticize

government efforts in the area of military training. The scope and complexity of activity is so diverse that examples can be found supporting almost any point of view. This chapter shall examine just some of these accomplishments, general problem areas, and future trends. Emphasis shall be given to attempts to implement educational technology and systematic instructional development procedures as a means for improving the effectiveness of training.

No formal definition of educational technology can be found which is accepted throughout the military training community. The authors, however, define educational technology in the broadest sense. That is, it is more than merely the hardware of training (e.g., computers, and television). In addition, educational technology includes all of the planning, designing, evaluating, and revising necessary to bring a training system to an adequate level of effectiveness (Association for Educational Communications and Technology, 1972). Unfortunately as this chapter will point out, the broad definition for educational technology described above is not always understood or used in military training.

The effort currently under way to improve military training encompasses a variety of the same challenges which are faced in non-military settings. Questions concerning human factors research, task analysis methodology, description of learning objectives, effectiveness measurement, and many other areas are being encountered and grappled with on a day-to-day basis. As an active test bed for educational technology the DOD presents great opportunities for growth. This chapter will not only provide constructive criticism, but will also explore the unprecedented challenges which await those working in military training. The chapter is basically intended for those readers who are familiar with the principles of educational technology, but who are not aware of the contributions which the military training community has provided to the field. It is hoped that the lessons learned from the application of educational technology principles to DOD training will be of benefit to those professionals who are laboring in other areas of education. The authors rely wherever possible upon the results of formal studies; however, some points in the chapter are based upon conventional wisdom, common sense, and personal experiences.

CURRENT METHODS AND PAST ACCOMPLISHMENTS IN MILITARY EDUCATIONAL TECHNOLOGY

The military establishment turned to educational technology as one means for meeting the challenges (i.e., training requirements which outstripped the growth of training resources) discussed in the previous section. A variety of processes and products resulted from the many efforts in the DOD training field. It is not possible in this brief chapter to review all of the contributions of military training to the field of educational technology. Therefore, this section will briefly highlight five key accomplishments by the armed services: the development of an inter-service instructional design model, the establishment of Instructional Program Development Centers, the large-scale development of exportable training packages, the implementation of individualized training, and training device development.

An Inter-Service Instructional Design Model

The Air Force assumed the lead, in the DOD, in the development and use of a systems-approach model for instructional design. In the late 60s the Systems Approach to Training (SAT) was developed. While systems methods of instructional development had been in existence in the military since the 1950s (Montemerlo, 1975), SAT's implementation represented the first time that an entire service had required all of its training activities to use the same model. The idea was that a great deal of redundant instructional development could be eliminated once all activities used the same procedural model. Experience in the production of instructional materials had shown that each Air Force training command had been approaching the effort in a variety of different ways. For example, one activity would not use materials developed by another. This "not-invented-here" syndrome, common to both military and non-military settings, was believed to hamper training effectiveness. The Air Force, realizing the harm in this situation, pushed hard to establish an instructional development approach which could be used service-wide.

The SAT contained all of the elements educational technologists had become accustomed to seeing in a design model (front-end analysis, objective derivation, media selection, instructional development, evaluation, etc.). Once this service-wide model had been established, improvements in many areas of Air Force training were noted: orderliness, completeness, relevance, economy, documentation, and evaluation all improved. (Sugarman, Johnson, Hinton & Buchemaier, 1975). The communication between the Air Force schools, the Air Force civilian training centers, and the contractors who developed much of the training material and media benefited greatly. Better training was the result.

The other military services took note of the Air Force experience. While these organizations had experimented with their own instructional design models (e.g., Systems Engineering of Training, Training Situation Analysis), the effectiveness of the efforts had been inconsistent. This was thought to be largely due to the fact that a variety of design models had been developed and used by different sectors of these services. There was no unified model, after the Air Force fashion, in any of the other services.

The Air Force's success prompted the development of a joint instructional design model

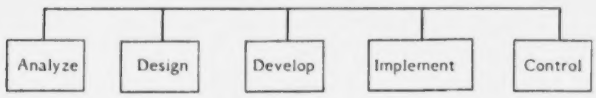

Figure 37-1. The five phases of the interservice procedures for instructional system development.

which could be agreed upon and used by all of the services. The model was ready for service-wide use in 1975 and became known as the Interservice Procedure for Instructional Systems Development (IPISD) (Branson, et al., 1975). This model has five main phases: Analyze, Design, Develop, Implement, and Control. Their relationship is displayed in Figure 37-1.

Within each phase there exists a number of distinct steps, each designed to move the model's user closer to finished products which are training effective. An excellent review of the model's development and use can be found in an article written by the model's prime developer (Branson, 1981).

The Air Force's success with the SAT convinced the other services that it was possible to develop a generic instructional design model which could apply to all military training. One service led the way, and in a rare show of unity the other services followed. However, agreeing upon one model proved to be easier than fully implementing that model. The difficulties encountered in the implementation attempt will be the subject of the "Problems" section of this chapter. The Navy developed a method of implementation which could have far reaching effects upon all of educational technology. That method will be the subject of the next section.

Instructional Program Development Centers

One of the Navy's main contributions to the field of military educational technology has been the concept of the Instructional Program Development Center. These centers, which are placed at key naval installations throughout the country, are staffed mainly by civilian instructional developers who carry out the detailed process of implementing the procedures called for by the Interservice Procedures for Instructional Systems Development described above. Specialists in such fields as task analysis, instructional design and media development, produce instructional materials for use at Navy schools. These centers develop products both in-house and under contract (Hodak, Middleton & Rankin, 1979).

The establishment of the Centers was spawned by the greater-than-anticipated difficulty of military instructional staffs at the formal schools to successfully produce instructional materials when using the IPISD methods. At least two factors may be responsible for this failure. First, the instructors often lacked the skills necessary to properly make use of the model. An instructional development model is just that--a model. A certain degree of flexibility is required in its use. Some steps may be combined or deleted, or extra steps may be added, depending upon the circumstances of the particular instructional project (Andrews and Goodson, 1980). In order to know which actions to take with a model like the IPISD model, at least some training is required in its use. Often the training provided instructors (Branson, 1978) proved to be insufficient for the development task; not because the training itself was poor, but rather because of the extremely high rate of instructor turnover. New instructors could not be trained fast enough. In essence, many instructors were often left to their own devices to operationalize the IPISD principles. Consequently, both the quantity and quality of instructor-produced materials left something to be desired (Montemerlo, 1979).

The second factor that caused the IPISD model to be difficult to fully implement at the school level related to the time it takes to accomplish any systems approach to instruction. The instructors often could not find the time to devote to the effort, given the many duties which they were required to perform (teaching, administration, inspections, etc.). IPISD development often took a back seat when weighed against other priorities. A statement made by Ansbro (1978) succinctly summarizes the problems: "It is simply asking too much of the instructor-jobholder to require or even expect versatility and solid competence throughout the range of instructional support duties commonly allotted to him. Can he reasonably be expected to write and revise lesson plans (published, official); compose, revise, and evaluate test items; devise or revise training aids; counsel and tutor trainees; and also perform ably as a platform lecturer and/or a "learning supervisor" in a self-paced or Cathode Ray Tube classroom environment?

In summary, the Instructional Program Development Centers have shown the potential of being a valuable addition to the Navy's capability to produce quality instructional materials. Despite some difficulties (e.g., initial difficulty in properly staffing the centers, difficulty in accurately estimating required funds, initial difficulty in

achieving full participation of fleet operational personnel in the program), the centers have gone a long way toward easing the strain on instructional staffs (Scanland, 1978). Their continued use by the Navy should help to further develop the concept of a "team approach" in instructional development (Carey and Briggs, 1977).

The Navy requires all of its Development Centers to use the IPISD model when designing and developing instruction. The Army also makes the same requirements of its instructional developers, and one major result has been an approach to training which can be utilized in almost any environment. That approach will be the topic of the next section.

Training Extension Courses

One of the Army's key contributions has been the Technical Extension Course (TEC) concept. These courses, of which over 2,000 had been produced by 1981, are fully exportable, self-contained instructional packages on a variety of topics. They are produced using the IPISD guidleines and generally use one of three delivery methods: Bessler Cue-See film projection system, audio tapes, or programmed instruction (Hanselmann & Perlman, 1981).

The Army came to the conclusion in the early 70's that many of its soldiers were not keeping up with advances in their specialties and required more training than they were getting in the formal Army schools. In addition, a great need for refresher training was realized.

Sending rather dry technical manuals to the soldiers in the field did not seem to be a satisfactory solution to the problem, due to their generally low motivational value. In addition, IPISD principles were not reflected in those technical manuals. Army training leaders decided that a large library of lessons was required for specialty training (both initial and refresher) which could be used in scattered and often remote locales throughout the world.

It was apparent that IPISD principles should be used for the design and development of the TEC lessons. However, defining the most suitable delivery tool took some effort. After examining a variety of possible instructional media choices, the decision was made to use the Bessler Cue-See system as a primary delivery tool, along with audio tapes and programmed instruction. The Cue-See system uses a self-contained projection method which allows film to be shown in still frames, or for instruction which required motion, in moving frames. The film and sound can be stopped so as to permit the student to answer questions or perform a task; then the student can reactivate the lesson. The projector is a compact, sturdy system which normally requires minimal maintenance and can be used in many environments (Arctic, desert, tropical, temperate, etc.). This TEC system has proven to be an excellent method of taking quality instruction to the field. Audio tapes are used for instruction when conditions do not allow the use of the Cue-See (by a soldier who is repairing a jeep, by a soldier who is on maneuvers, etc.).

The Army Research Institute has evaluated the training effectiveness of the TEC program and found that this method taught the lessons more effectively than did conventional instruction, led to better retention, and cost 16 percent less than did traditinal instruction. In addition, TEC surveys have frequently shown a positive attitude toward the entire program.

The instructional packages may include technical manuals (or simplified versions of them), tests, the Cue-See film packages, audio tapes and programmed instruction. Presently they are being used throughout the world. The Army is now investigating the use of video-disc as a replacement medium for the Bessler Cue-See.

The TEC lessons represent a use of educational technology on a wide scale which combines advanced media with systematic instructional design. They make use of the individualized instruction approach to training, a concept which has had a large impact upon military training. This impact will be the topic of the next section.

Shift to Individualized Instruction

One major aspect of educational technology which all of the services have agreed upon and attempted to implement has been individualized instruction. The military has set minimum standards for intellectual and academic requisites. It is normally expected that recruits will be high school graduates and be able to read at least at the eighth grade level. (The end of the draft in the early 70's caused a decline in number of recruits with even these minimal qualifications). There is, as one might expect, a great deal of variability in the quality of the recruits who enter the service. (Once again, the end of the draft saw a reduction in the overall variance, as potential recruits with high qualifications tended to stay away from military service). This variability caused many problems in military schools when group-paced approaches were used. The same problems which are troublesome in group-paced public schools and colleges also were apparent in these military training schools. Boredom for high achievers, bewilderment for low achievers, and frustration for instructors became quickly apparent. Due partly to these reasons, military personnel who graduated from lockstep schools often lacked the skills and knowledge required of them in their military duties. Maintenance requirements sometimes went unmet, weapons operators sometimes were unsure in their tasks, and total military preparedness ultimately suffered. The armed forces were finding such occurrences at a very alarming rate when group-paced approaches were used. Certainly, the group-paced approach was not the only reason for these training problems, but it was thought to be a significant contributing factor.

The slow learners suffered more than the rest

because the pressure to get them graduated and out of the schools was great. Reduction in total manpower required every available person to be quickly placed in operational units. In addition, new classes of students coming into the schools did not leave any space for previous students who had either failed classes or merely needed extra help. The group-paced assessment systems were often not performance-based and consequently did not allow the instructional staff to identify students who were not truly adept at the required skills. This made remediation all the more difficult.

In order to counter the problems cited above, the military turned to individualized instruction. These methods, now used in most military training schools, have allowed instructors to focus upon students who are having trouble. Individualized instruction has also fostered the development of performance-based assessment approaches. As Montemerlo (1975) points out, the military operationalizes individualization by making use of proficiency-based advancement within the course, and proficiency-based graduation from the course.

The use of individualized instruction does not mean that the military has abandoned traditional instructional methods, such as lectures. Nor does it mean that group-paced classes have been entirely done away with. It does represent, however, a significant advance in military training thinking which has allowed the needs of the trainee to be better defined and accommodated (Zajkowski, et al., 1979).

A variety of techniques for administering individualized instruction have been explored. This chapter has already reviewed the TEC method. The next section will explore an additional method--the simulation training device.

Military Training Devices

In the early 1940's an innovation came upon the training scene which has had considerable influence upon military training and has grown into a multi-billion dollar industry. That innovation was the Link simulator for pilot training. Here was a device which allowed initial training and practice in flight training in a safe environment, at a relatively inexpensive cost. As the requirement for hugh numbers of pilots became more acute, the military turned increasingly to this simulator. It allowed a trainee to make his first real flight with considerable knowledge and skills in aviation already at his command. Thousands of pilot trainees made use of this training device.

Since the early Link trainer, simulators of all kinds and varieties have been used by all of the services. Simulators have been developed for maintenance training, weapons operation, tactical training, team training, and many other uses.

Simulators have a variety of benefits which are being increasingly realized by military decision-makers. Some of the advantages are listed below:

- Simulators usually cost considerably less than the operational equipment they replace.
- Simulators are safer than operational equipment
- Simulators provide more hands-on practice than operational equipment will allow. (This feature allows increased capacity for individualizing instruction. Slower learners can spend more time on the device.)
- Simulators are usually easier to maintain than are operational equipment.
- Use of simulators frees operational equipment for use in the field.

One very important advantage that accompanies simulator use is the special training functions available with them (e.g., the capability to freeze and play back training sessions, diagnostic recordkeeping, easy malfunction insertion, and automatic comparison of trainee performance with criterion performance). Operational equipment seldom can be adapted to include these functions.

The military is increasingly coming to realize that just building a simulator which exactly looks like and duplicates all of the functions of the operational equipment will not necessarily produce better training. Requests have been frequently voiced in the past, by personnel in the field, that the simulator have "high physical and functional fidelity" with the operational equipment that it is stimulating. While this high fidelity is "nice to have," it can be expensive to obtain and may add nothing to the training effectiveness of the simulator (Gagne, 1971).

More important to training than is "physical and functional fidelity" is "psychological fidelity." This term may be defined as being the various cues which prompt student behavior in a training setting. In order to achieve the maximum amount of transfer from the training situation to the real world, a detailed analysis of the various stimuli and responses inherent in the task is necessary. Once these psychological task components have been defined, they can be incorporated into the training device. This incorporation is often not possible when high physical and functional fidelity is demanded, because the operational equipment is built with the requirement that an expert operate the equipment. The operational equipment does not make allowances for novices who are not able to recognize all of the cues and to display all of the proper behaviors. Consequently, when a simulator reflects the exact appearance and function of the operational equipment the trainee, who is not an expert, may not be able to recognize the cues or respond with the appropriate behavior. Psychological fidelity of the simulator with the operational situation is often not obtained.

As the instructional features mentioned above, such as feedback and record keeping, are incorporated into simulators, the simulators become "training devices" whose primary purpose is to provide training by means of psychological

fidelity. The adoption of this concept by the military represents a major breakthrough. What is needed for effective training are "training devices" which present appropriate psychological cues for novices. Merely producing simulators is usually not sufficient for training purposes. Technological advances have made these devices possible, and they are being exploited more and more by every branch of the armed services.

Summary of Accomplishments

This brief discussion has examined but five accomplishments that the military community has achieved. The development of the Interservices Procedures for Instructional System Development model, the establishment of the Instructional Product Development Centers, the success of the Training Extension Courses, the military's progress in individualized instruction, and the use of training devices all represent examples of the DOD's commitment to educational technology. These advances have not come without problems, which will be the topic of the next section. However, despite these difficulties the military has been a viable team member in the development of the field of educational technology.

PROBLEMS ENCOUNTERED WITH EDUCATIONAL TECHNOLOGY APPLICATION WITHIN THE DEPARTMENT OF DEFENSE

The armed services have been at the forefront of educational technology development since the inception of the field. The DOD has contributed a considerable amount of the total growth to educational technology, as discussed in the previous section, and in turn has reaped many significant benefits. However, as is the case with any pioneering effort, problems and limitations have surfaced when educational technology applications to military training have been seriously examined. Such is to be expected when a set of innovations of such proportions is applied to a large organization such as the military. These problems have not resulted in the military's abandonment of educational technology. On the contrary, the advantages of using this technology have been much too apparent for such an action to be warranted. Rather than abandonment, a continued effort in the identification of problems and problem-solutions has resulted.

Identification and discussion of these difficulties is necessary if further progress is to be made. It is vital that weaknesses in the military training system be pointed out. Such is the purpose of this section. This discussion of problems is intended to point out significant challenges which, if fully met, could have a far-reaching impact upon the state-of-the-art in educational technology not only in the military but in many other training and educational settings.

Seven problem areas will be discussed in this section. Certainly others could be identified, but these seven seem to the authors to be especially important. In some of the seven cases the authors suggest possible alternative solutions. In others, the authors confine themselves merely to problem identification. In these cases, the discussion of alternative solutions would either be too detailed for the scope of this chapter or no viable alternatives could be identified at present.

The problems are discussed and ordered within the framework of the IPISD model whose phases, once again, are Analyze, Design, Develop, Implement, and Control. While some of the problems may be related to more than one of the five phases, the decision was made to concentrate each problem on that phase to which it is most relevant. This was done to make the sequencing of the problems more logical.

Phase I - Analyze

Problem 1: Failure to Integrate the DOD Budgetary Process With the Training Analysis and Design Process

The influence of the DOD budgetary process has a great impact upon the educational technology efforts of the military. This fiscal planning must often start seven years before the innovation is actually introduced to the trainees. From a distance it may appear that this detailed planning is of great help to those concerned. However, for those professionals intimately involved with the process it can be highly counterproductive. One very critical problem towards which this process contributes is the tendency to focus the military's sights upon hardware procurement to the detriment of training. Enormous amounts of effort are expended in defining and procuring the expensive operational equipment (planes, ships, tanks, etc.). Training needs are often no more than an afterthought, and instructional development frequently does not proceed along with hardware development (Scanland, 1978).

The lack of integration of hardware with training, which is in large measure due to the long budgetary process, is illustrated in the following quote from the Office of the Chief of Naval Operations:

> "Although the weapon system acquisition process has been subject to extensive specifications and control, the identification and evaluation of manpower, personnel and training resources associated with a proposed system design traditionally has not occurred until late in the hardware systems development. In theory at least, hardware design was responsive to mission requirements and necessarily of primary importance; supportive considerations, therefore, were given little attention until program decisions concerning weapon design and development

were made. The result has been the increasing difficulty experienced by the Navy in supplying sufficient numbers of qualified, trained personnel to meet operational needs." (CNO (OP-112C), Hardman Methodology Handbook, 1 Nov 1980).

A second aspect of the budgetary problem is associated with the actual cycle of the DOD fiscal year. Funding for training is allocated to large training agencies, which in turn divide it among various DOD working groups or external contractors. The DOD working group (e.g., educational specialists, psychologists, and engineers) must build a schedule around the fiscal year. Money not committed prior to the end of the year often reverts to the sponsor; there is thus a great pressure to compress schedules in order to obligate the funds. These procedures often leave little time for the analysis necessary to assure quality training. The emphasis is too often placed upon the demands of the comptroller's offices rather than upon the demands of the training systems.

Problem 2: Failure to Fully Analyze the Task and the Learning Environment

Although task analysis has been recognized as a key step in military training design (Branson, 1975), its implementation is frequently incomplete or shallow. The distinction between a task listing which simply names activities, and a detailed task analysis which includes information on how a task is performed and to what standard, is often not fully understood. Despite an increased effort in the task-analysis area in the last few years, there still remain many military courses which are not based upon a firm analysis of the tasks which the trainee must accomplish. Often, they are rather a reflection of the personal experiences of the instructors, which vary greatly from one to another. Linked with the problem of an abbreviated task analysis is the frequent failure to fully analyze the training situation so that a training strategy can first aim at the right performance criteria, and secondly can take into consideration the facilities, media resources, equipment, and human resources required to meet those criteria.

The identification and resolution of these problems is currently progressing, but they will continue to plague development efforts for some time to come. The demand for quality training analyses frequently outstrips the resources available within DOD for accomplishing these analyses. A complete task analysis is highly manpower--intensive work, much of which must be performed in the field. Task analyses lasting 1 - 2 years for a complex course are not uncommon. Formal school personnel are often too busy with day-to-day tasks to be able to devote full time to analysis efforts. The Instructional Program Development Centers of the Navy have a huge backlog of work that will not allow them to address all of these task analyses. Contracted efforts can be very expensive (analysis efforts of $500,000 plus are becoming more frequent). This large level of effort often surprises the uninitiated, and unfortunately management decisions at all levels of training are still being made which fail to take these factors into account. The necessary resources and time are seldom programmed for quality analyses, and consequently the eventual training systems have inherent weaknesses.

PHASE II - DESIGN

Problem 3: Substitution of Trivial Objectives For More Meaningful, But Difficult-to-Measure, Objectives

The need for "objectives" as a focusing point for instructional development is well understood and widely practiced (Kapfer, 1977). It is such an article of faith, however, that subtle problems are often overlooked when dealing with objectives.

It is usually argued that objectives should be derived from an analysis of a task or function. However, is must be realized that instructional objectives are specified based upon a value orientation, but with no direct relationship to an observable task. An example might be the general insistence that students learn basic algebra before going on to fundamentals of radio repair. The first reaction on the part of military developers to this method of arrivng at objectives was to eliminate it completely, in favor of a strict linkage to a narrowly-defined job (e.g., Dougherty & O'Neill, 1978). The call for the elimination of "nice-to-know" objectives which do not bear directly upon the job task has been heard frequently in military training circles. This reaction has created problems when it has been applied in some cases. The result of this policy may have led to the abandonment of many significant but hard-to-measure objectives in some military training in favor of trivial but more-easily-measured objectives.

It is widely held within the military that instruction must be purged of anything not directly linked to a specific job. However, jobs in this regard may be conceived in a very narrow sense. The goal of training becomes limited to meeting the requirements of the narrow job. While it is definitely necessary that these job tasks be well learned, this proclivity for instruction which is extremely job-specific may limit the development of the trainee beyond the narrowly-defined job. Instructional algorithms are created which feature the trainees as integral parts of the training system, but the trainees are often not able to expand their skills beyond that system because they have become used to trivial, easily-achieved objectives.

This policy of limited-skills training may work reasonably well when conditions for defense training are optimal (i.e., there is adequate time to train each trainee for a well-defined job, and remedial help can be given where it is needed).

However, trouble may become apparent during times of stress, when the training environment is not ideal (manpower shortages, rapid increases in high technology, many team-work requirements, etc.). In such cases, students may have to increase the volume of complex tasks they learn, and learn them at a much faster pace, in order to cover manpower shortages. Team-work requirements put an increased burden on the students to become cognizant of more than just their assigned job-tasks. They must become involved in complex interactions with other machines and people. When these less-than-optimal training situations arise, students and instructors who are used to dealing with trivial, easy-to-measure objectives may have difficulty in making the transition to more complex, but difficult-to-measure objectives.

Despite some success in the past years in the area of instructional objectives development, military developers have no reason to be complacent. In fact, they should rigorously examime the use of objectives in building training programs. It must be remembered that quality objectives are more than just a matter of good format. The goal of an instructional objective is to ensure coherent, fully functioning performance when the trainee moves to the total job environment. That job environment may require the trainees to rapidly expand their skills beyond the boundaries set in training schools. The constant use of trivial objectives in the training environment may make this expansion difficult.

Phase III - Develop

Problem 4: Failure to Consider the Need For Effective Motivation in Some Training Programs

The problem of a lack of consideration for proper motivation in military training is by no means universal. It occurs often enough, however, (Naval Technical Training Command, 1977), to warrant inclusion in this discussion of educational technology problems.

Current instructional programs often tend to reflect a variety of needs: budgetary, administrative, engineering, and those of the instructional developers. Unfortunately, learner needs are not reflected as often as they should be. The wide variety of trainees entering the armed forces requires an array of varying motivational techniques for training (individualized instruction, peer recognition, rewards such as increased free time, more rapid promotion, etc.).

Quality instructor-student relationships, self-accomplishment, peer-group cooperation, and command support are just some of the important components of an effective motivational approach. Yet these factors may be poorly managed by instructional developers working for the military when they concentrate upon developing effort does not consider all of the unique features in each individual training situation which might have an impact upon motivational strategies. The result may be instruction which is devoid of rewards that are linked to active student learning.

Renewed emphasis upon the training of all military school personnel in the IPISD methods could alleviate much of this motivation problem. Since these instructors are "on the scene" there is a good chance that instructional materials developed by them would foster increased motivation in their students.

Problem 5: Failure to Provide a Detailed Strategy of Instruction

When a systems design model, like the IPISD model, is used for instructional development, a fairly well-defined groups of steps is prescribed. Some of the more common steps are: Task Analysis, Selection of Tasks to be Trained, Writing of Objectives with Standards and Conditions, Media Selection and Prototype System Development. In addition, the rational selection of a detailed Strategy of Instruction is called for in virtually every model of instructional design (Andrews and Goodson, 1980). Unfortunately, often in military training development, the selection of a strategy of instruction consists of nothing more than a gross designation of a delivery method ("lecture," "slide tape," "film," "video tape," etc.). Instructional strategy formation if often neglected because undue emphasis is placed upon the many media selection models which have been developed, both by contractors and by the government. The task of selecting media should follow the procedure of instructional strategy formulation, not precede it or substitute for it.

An instructional strategy, at the very least, must stipulate learning events, along with the sequence in which they will be addressed during instruction (Gagne and Briggs, 1979). It additionally would be helpful to include message design features and provisions for learner reinforcement in the strategy. A media selection strategy only makes sense in terms of an overall instructional strategy. The failure to fully realize the distinction may account for the inadequacy of many media selection models to ultimately be of substantive assistance in the production of quality training programs. Some media selection models are actually so circular that they seem to require a preliminary media choice ahead of time in order to make them work. Others are simply elaborate and very esoteric justifications for prior decisions.

This confusion will most likely persist in military instructional development for some time to come because many government "Requests for Proposals" as well as "Military Standards and Specifications" incorrectly emphasize media selection over instructional strategy formulation. This is an example in which the original weaknesses of development efforts have become fixed by the weight of continued practice and bureaucratic inertia.

Phase IV - Control

Problem 6: Failure to Identify and Resolve Evaluation Problems

Instructional developers frequently experience discomfort under the scrutiny of evaluation. The evaluation technology field has grown tremendously over the last few years, but the natural resistance to it by developers often seems to persist. Problems of insufficient data, inappropriate data, or untimely data have combined with general confusion over evaluation and test construction methodology to reduce evaluation utility in military applications of instruction. Failure to use the findings of evaluation studies in all training fields has been referred to as almost reaching the proportions of a national scandal (Guba & Lincoln, 1981).

The use of evaluation data in military training has in some cases gone beyond the mere improvement of instructional techniques and materials. Many contractors must now show performance improvements, based upon evaluation data, before they can be paid. In the military, this type of evaluation is known as "effectiveness testing" (Neal, 1978). In principle, effectiveness testing is the logical partner of performance contracting (Lessinger, 1970) which had a run of popularity some years ago in formal education. Practical procedures and models for effectiveness testing are still evolving (Finley & Strasel, 1981).

Since military training is more directly related to actual job performance than is most of formal education, its evaluation goals are usually geared more towards showing proficiency in a real-world setting. These real-world goals can lead to special evaluation problems and errors. Three of these errors are discussed below.

The first source of evaluation error is related to the quality of the needs-assessment effort that went into the specification of the performance requirements for the new training system. When the training program is designed around ill-defined needs, or needs which do not come from real-world problems, the program will most likely be difficult to properly evaluate. It is one thing in an evaluation to demonstrate the effectiveness of a training program in achieving objectives which were selected because the program happens to teach those particular objectives well. It is quite another thing to demonstrate the effectiveness of a training program in achieving objectives that relate to a real-world military need (Kaufman & English, 1979). Many military training programs produce impressive evaluation results, but since those programs were based upon poor needs assessments, the program is of no real use to the military.

Selection of an appropriate intermediate performance criterion is the second source of possible evaluation error. Most military training systems are aimed at providing training which will transfer to combat skills, and which must be usable under stress. A truly effective training program will prepare individuals for these conditions. In many cases this ultimate combat criterion can only be approximated, and so some intermediate criterion is selected as the standard which gauges effectiveness. When the intermediate criterion which is selected for evaluation does not approximate the necessary real-world behavior, the evaluation may not have a proper goal.

For example, in training a soldier to use an anti-tank weapon, the intermediate criterion of achievement might be the hitting of a simulated target with the weapon's rocket. This criterion may not, however, be the most appropriate indicator of training success. The trainee may use the wrong procedures and still hit the target in an unrealistic testing situation. When these incorrect procedures are applied in a real combat setting, the trainee may perform poorly and consequently not hit the target. An error in the selection of the intermediate criterion or evaluation could eventually have disastrous consequences.

A third source of evaluation error is related to the populations used for the evaluation. Occasionally, nonrepresentative popoulations, or populations exposed to prior learning, are used to demonstrate the effectiveness of a training system. There is great pressure on contractors to have the trainees "pass" the effectiveness test. Consequently, these contractors may frequently want to use the same military personnel who used the prototype training materials during system development to demonstrate system effectiveness. They may also want to use their own personnel to demonstrate the system. The evaluation of the new system with these populations does not, of course, ensure that the system will be effective with the target population. It is not just contractors who contribute to this problem. Often the government cannot provide the test-subject personnel required for strong inference-type testing. In order to avoid the use of these invalid test populations, the government workers who monitor contracts must exercise stringent control at all phases. Time and resource pressures often combine to make this strict control difficult, but it must be the rule if effective evaluation is to take place.

All of these problems and sources of evaluation error can still be observed in many current instructional development efforts within DOD. Failure to eliminate these evaluation errors will probably be a problem for some time to come.

Problem 7: Failure to Make Full Use of the Iterative Nature of the IPISD Process

One of the characteristics of the systems approach is the identification of performance requirements which define the product or products to be created. A great deal of learning theory, management technique, and instructional design expertise are invoked and utilized in progressing throught the steps of the IPISD model. However,

in spite of the best attempts to meet these performance requirements, often there is a large gap between student achievement on the prototype material and the requirements which were set up as performance criteria for the training system. The iterative provision inherent in all systems designs (recursive mathematical models, artillery bracketing, etc.) could correct this situation since it provides the requirement to keep revising until the criterion performance is realized.

The problem is, however, that even though most system models emphasize this revision characteristic, the process is sometimes not used in practice. The pressures of designing to cost and contracting to schedule often cause the acceptance of a less-than-adequate product because the revision process has not been implemented. Often too, the process of development is such a trial for the untrained and unskilled, who are frequently forced into development roles, that they recoil from the thought of going through the loop again. Their desire is to terminate the project as quickly as possible.

Another contributing factor to this problem is that performance requirement criteria are often poorly specified to start with. Consequently, it becomes easier to adjust the performance requirements to the results initially obtained, no matter how unsatisfactory they may be, rather than to keep working for better results via the iterative process.

Then to the extent that these conditions tend to characterize many development efforts, there is little likelihood that the iterative nature of the development process will be exercised. The resulting unsatisfactory training programs may cause people to blame the systems approach itself, rather than the method by which it was applied to the development effort.

Problem Summary and Conclusions

This section has highlighted seven problems in current applications of educational technology to military training. There are certainly others, but these seemed to the authors to be of key importance. Briefly, they are:

- Failure to integrate the DOD budgetary process with the training analysis and design process
- Failure to fully analyze the task and the learning environment
- Substitution of trivial objectives for more meaningful, but difficult-to-measure, objectives.
- Failure to consider the need for effective motivation in some training programs
- Failure to provide a detailed strategy of instruction
- Failure to identify and resolve evaluation problems
- Failure to make full use of the iterative nature of the IPISD process

The striking fact about all of these problems is that solutions to them can generally be found within the IPISD model. The model addresses, either directly or indirectly, each of these issues. They continue to be problems mainly because various constraints (e.g., political, monetary) and attitudes prevent the proper application of the IPISD principles. The authors are not suggesting that the IPISD model is a complete panacea for all training problems. Branson (1978), for example, has pointed out that the IPISD model was not intended to serve all military training needs. Rather, it was basically intended to focus upon the technical training needs of enlisted personnel. Instead, the authors are suggesting that the guidelines for instructional analysis and development which the model establishes can lead, when properly applied, to the elimination of many training roadblocks. Until the entire military training community recognizes these difficulties and systematically works on their resolution they will remain in the problem category, instead of the accomplishment category. The next section will briefly describe some trends which may help to operationalize possible solutions to these problems.

TRENDS FOR THE FUTURE

When we couple the history of educational technology in the Department of Defense with the rapid advances being made both within and without the DOD, it is difficult to list all of the possible trends. However, a few seem to be of special significance and will be discussed in this section.

First, there will be an expansion of the use of computers in various educational and training applications. The use of computers in training has proven extremely useful and seems to have advanced well beyond the educational "fad" stage. There have been some disappointments with this technology (Orlansky and String, 1980). These have, however, been relatively few when compared to the total breadth of computer application.

Much of the recent interest in the use of computers for training is due to the development of the micro computer. Micros allow training control at the school level. This control facilitates the development of self-contained training programs to deliver a great variety of interactive instruction. Larger mainframe computers will be increasingly linked with several training commands over great distances (Micheli, et al., 1980; Summer, 1979; Fletcher, 1975). This will allow greater cost-effectiveness as more students are able to use the same courseware. Computers of all sizes will be relied upon more and more for both instructional delivery and instructional management (Dougherty and O'Neill, 1978).

Experiments with "artificial intelligence" and "reactive learning environments" have been conducted for the Air Force and they have resulted in such computer-based teaching systems as "SOPHIE" (Sophisticated Instructional Environment) (Brown et al., 1974). This system

approximates the use of a tutor to interact with the student. It features a natural language processor to facilitate limited man-machine dialogue and bases computer responses upon interactive simulations of the learning content rather than upon strict preprogrammed or fixed responses to set inquiries. Another current effort is represented by "NEOMYCIN" (Clancy and Letsinger, 1981). The use of such systems is likely to increase as the technological problems are gradually solved. Instructional developers will surely be involved with defining content and extending the use of such systems (Brown et al., 1974; Gunwaldsen, 1975).

Computer models are now being devised to assist in the use of evaluating new innovations in educational technology (Duffy et al., 1977). This area of development will also be typical of the many computer tools which will be available to the military-oriented instructional developer. These developments, of course, are not the last word. Research will continue; and Hickey (1974) has proposed research guidelines to further efforts related to computer-assisted instruction.

There will also continue to be accompanying problems associated with an over-emphasis of computer hardware versus courseware development. This emphasis often causes gross underestimations as to the time, effort and money required to supply computer-oriented training with the essential courseware needed for valid instruction. However, even this problem will not reverse the trend toward greater expansion of computer usage.

A second trend will be the increased emphasis that will be placed upon determining the cost effectiveness of training systems being developed within DOD. The need for this evaluation has been recognized since the days of the McNamara Defense Department in the mid 1960's. However, in practice the analysis of costs and benefits has remained at a very gross level. As training continues to take a smaller percentage of the total DOD resource outlay, it will become even more important that the cost-benefit of each dollar spent for training be carefully accounted for. Efforts are now being made to refine these methods to fit specific applications in training development (Donahue, 1980; Neal, 1978; Orlansky and String, 1977).

A third trend is also due in part to the resource problems which military training concerns are presently encountering. The tremendous need for analysis, design, and development of training systems for the military will far exceed the government's ability to provide this service through in-house resources (Ansbro, 1978). In the immediate future there will be a trend toward the expanded use of contractor help to design and produce training systems for use by the armed forces. This will take place even where the use of contractor personnel is extremely costly. The government's own instructional development personnel will be increasingly utilized in the needs assessment, initial problem definition, front-end analysis, and contract management roles, while the follow-on development work will be mainly accomplished by contractors.

A final trend, which is becoming more pervasive throughout the entire field of educational technology, is the attention being given to cognitive psychology (Lowe, 1980). The early influence of behavioral psychology upon the field of educational technology was quite pronounced. The military training community was no different in its acceptance and use of behavioral principles. However, now, as the importance of cognitive factors (motivation, attention, information processing strategies, etc.) is gaining more emphasis, the military training community is starting to examine the benefits which can be derived from combining both behavioral and cognitive psychology. A better "mix" of training concepts, utilizing principles from each psychological area, is the result and further work is bound to continue (Miller, 1980).

CONCLUSIONS

It is difficult to reach definitive conclusions with regard to the use of educational technology within the military. Certainly, this chapter has not captured the entire military training situation. Considering the great training challenge, we can say that few opportunities exist with a greater potential for proving the merit of educational technology. If the problems facing the field can be overcome, the state-of-the-art of military instructional development will indeed be representative of the promise inherent in the educational technology enterprise.

Several conclusions regarding the state of DOD training can be emphasized. First, the effort to use untrained and unskilled personnel in the development role to implement the various instructional development models has not been very successful. The most progress in this area seems to have been made where pockets of well-trained professionals have existed (Ansbro, 1978). More help must be directed at the point of instruction, the formal military schools. The instructional development models cannot carry the load without people who can translate the logic of the model into practice.

A second conclusion centers around the need for broader and more rigorous training of instructional systems developers who wish to fill a military role. Few educational institutions offer a curriculum which fully prepares instructional developers for the tasks which they will perform when working in nonacademic settings. The public school teacher-oriented curriculum only partially fills the need. In addition to instructional development courses, computer science, business, research, and evaluation courses must be more fully utilized in the training of prospective military instructional developers.

A final conclusion concerns the importance of a national commitment to quality military training. The issue of how strong the U.S. defense

services should be, when compared to those of other countries, has been a much-discussed topic in the last few years. This debate has been precipitated by intelligence reports which indicate that the U.S. defense now has fewer people and fewer traditional weapons (planes, ships, tanks, etc.) than its most like foe. The U.S. response has been an increasing reliance upon high technology to fill the gap. A large portion of the defense responsibilities now resides in very sophisticated defense systems.

This same reliance upon high technology has been transferred to military training in order to fill the training gap created by such factors as fewer instructors, more complex courses, and trainees with fewer academic skills. As this chapter has attempted to point out, the results of this technology application have been mixed. Educational technology, when narrowly defined as merely sophisticated delivery systems (computers, television, etc.), will not fill this training gap. Even when the broader definition for educational technology used in this chapter (planning, research, evaluation, etc.), is accepted and its principles used, the gap between training delivered and training needed may not be filled entirely.

In addition to aid from educational technology in solving training problems, there should be a recognition at political levels, where money for defense is allocated, that more resources for training are required. The sophisticated weapons systems will be of little use if the humans who operate and maintain them lack the necessary skills. Such training considerations as longer periods for training, more instructors, and more incentives for retention of skilled training personnel are very likely required if defense readiness is to be attained. Educational technology alone cannot solve the military's training problems. In addition, national resolve for quality military training must be understood and acted upon at the political level if the armed services are to meet their security commitment.

REFERENCES

Andrews, D.H. and Goodson, L.A. A comparative analysis of models of instructional design. Journal of Instructional Development, Summar, 1980, Vol. 3, No. 4, pp. 2-16.

Ansbro, T.M. The instructional technologist and the instructor in armed forces schools. Educational Technology, March 1978, Vol. 18, No. 3, pp. 20-23.

Association for Educational Communications and Technology. The field of eduational technology: A statement of definition. Audio-visual Instruction, 1972, 17 (8) pp. 36-45.

Branson, R.K., Rayer, G.T., Cox, J.L., Furman, J.P., King, F.J., and Hannum, W.H. Interservice Procedures for Instructional Systems Development (5 volumes) (TRADOC Pam 350-30 and NAVEDTRA 106A). Ft. Monroe, VA: U.S. Army Training and Doctrine Command, August 1975.

Branson, R.K. The interservice procedures for instructional systems development. Educational Technology, March, 1978, Vol. 18, No. 3, pp. 11-14.

Branson, R.K. Applications research in instructional systems development. Journal of Instructional Development, Summer 1981, Vol. 4, No. 4, pp. 14-16, 27-31.

Brown, J.S., Burton, R.R., Bell, A.G. and Bobrow, R.J. SOPHIE: A Sophisticated Instructional Environment. Air Force Human Resources Laboratory Technical Report, 74-93, December 1974.

Bushnell, D.S. The Impact of Instructional Technology on Training in the U.S. Army. Human Resources Research Organization, Alexandria, VA, July 1976.

Carey, J., and Briggs, L.J. Teams as Designers. In L.J. Briggs (Ed.), Instructional Design - Principles and Applications. Englewood Cliffs, NJ: Educational Technology Publications, 1977.

Clancey, W.J. and Letsinger, R. NEOMYCIN: Reconfiguring a Rule-Based Expert System for Application to Teaching the Proceedings of the 7th IJCAI, 1981, pp. 829-836.

Donahue, J.P. (Ed.) Cost Benefit Analysis and Project Design. United States Agency for International Development and the Program of Advanced Studies in Institution Building and Technical Assistance Methodology, Bloomington, IN, 1980.

Dougherty, A.J. and O'Neill, H.F. An overview of training and the use of educational technology in the Department of Defense. Educational Technology, March, 1978, Vol. 18, No. 3, pp. 5-10.

Duffy, L.R., Miller, R.B., and Staley, J.D. Design of Training Systems: Computerization of the Educational Technology Assessment Model (ETAM) Volume I. Training Analysis and Evaluation Group, Report No. 40, Orlando, FL, May 1977.

Duffy, T.M. and Nugent, W.A. Reading Skill Levels in the Navy. Navy Personnel Research and Development Center, NPRDC TR 78-19, San Diego, CA, April 1978.

Ebel, R.L., Noll, V.H. and Bauer, R.M. (Eds.) Encyclopedia of Educational Research (4th ed.) New York: McMillian, Inc., 1969

Finley, D.L. and Strasel, H.C. Early Device Testing: The Training Effectiveness Potential Testing Concept and Its Application. Paper presented at the conference on front-end analyis for simulator and device based training. Sponsored by the Society for Applied Learning Technology. Arlington, VA, July 1981.

Fletcher, J.D. Computer Applications in Education and Training: Status and Trends. Navy Personnel Research and Development Center, Technical Report 75-32, San Diego, CA, April

1975.

Gagne, R.M. Training devices and simulators: Some research issues. In Howell, W.C. and Goldstein, I.L. (Eds.), Engineering Psychology: Current Perspectives in Research. New York: Meredith Corporation, 1971.

Gagne, R.M. and Griggs, L.J. Principles of Instructional Design (2nd ed.). New York: Holt, Rinehart, and Winston, 1979.

Government Accounting Office. A Need to Address Illiteracy Problems in the Military Service, 1977.

Guba, E.G. and Lincoln, Y.S. Effective Evaluation. San Francisco: Jossey-Bass, 1981.

Gunwaldsen, R.L. CHARGE Image Generator: Theory of Operation and Author Language Support. Human Resources Research Organization, 300 N. Washington, St., Alexandria, VA, Technical Report No. 75-3, May 1975.

Hanselmann, C.F. and Perlman, J. U.S. Army training extension course - after 5 years in operation. Air Defense Magazine, Ft. Bliss, TX, Jan - Mar 1981, ppg. 16-18.

Hickey, A.E. Research Guidelines for Computer-Assisted Instruction. Newburyport: Albert Hickey Associates, 1974.

Hodak, G.W., Middleton, M.G., and Rankin, W.C. Institutionalization of Instructional System Development (ISD) in the Naval Education and Training Command: An Organizational Analysis. Training Analysis and Evaluation Group, Report No. 70, Orlando, FL, May 1979.

Kapfer, M.B. Behavioral objectives: The position of the pendulum Educational Technology, May 1977, Vol. 17, No. 5, pp. 5-6.

Kaufman, R.A. and English, F.W. Needs Assessment - Concept and Application. Englewood Cliffs, NJ: Educational Technology Publications, 1979.

Kaufman, R.A., Stakenas, R.G., Wager, J.C. and Mayer, H. Relating needs assessment, program development, implementation and evaluation. Journal of Instructional Development, Summer 1981, Vol. 4, No. 4, pp. 17-26.

Lessinger, L.M. Engineering Accountability for results in public education. Phi Delta Kappan, Vol. 11, No. 4, December 1970.

Lowe, W.C. Changes in instructional development: The aftermath of an information processing takeover in psychology. Journal of Instructional Development, Winter 1980-81, Vol. 4, No. 2, pp. 10-18.

Micheli, G.S., Morris, C.L., and Swope, W.M. Computer Based Instructional Systems...1985 to 1995. TAEG Report No. 89, Training Analysis and Evaluation Group, Orlando, FL, August 1980.

Miller, G.G. The relevance of cognitive psychology to instructional technology. Proceedings of the Second Interservice - Industry Training Equipment Conference. Salt Lake City, Utah, November 1980.

Montemerlo, M.D. Instructional Systems Development: Advantages and Limitations. Unpublished manuscript, 1975.

Montemerlo, M.D. The Instructional System Development Manual: Tool or Tyrant? Paper presented at the American Psychological Association Annual Convention, New York, September 1979.

Naval Technical Training Command. Training Motivation Conference Program. Memphis, Tenn., 26-27, July 1977.

Neal, G.L. Cost and training effectiveness analysis. Educational Technology, March 1978, Vol. 18, No. 3, pp. 15-19.

Orlansky, J. and String, J. Cost Effectiveness of Flight Simulators for Military Training, Volume I: Use and Effectiveness of Flight Simulators. IDA Paper P-1275: Institute for Defense Analysis Science and Technology Division, Arlington, VA, 1977.

Orlansky, J. and String, J. Cost-effectiveness of computer-based instruction for military training. Proceedings of the Second Interservice - Industry Training Equipment Conference, Salt Lake City, Utah, November 1980, pp. 125-138.

Rose, M.R. Instructional technology in the Department of Defense, now and in the future. Paper presented at the International Learning Technology Congress and Exposition on Applied Learning Technology for Human Resource Development (Washington, DC, July 21-23, 1976).

Scanland, W. Centralized course development in the Navy. Educational Technology, March 1978, Vol. 18, No. 3, pp. 24-27.

Sugarman, R.C., Johnson, S.L., Hinton, W.L., and Buchemaier, C.C. SAT revisited - A critical post-examination of the systems approach to training. Paper presented at the Human Factors Society Meeting, 1975.

Summer, C.F. A new concept for application of microcomputer technology to real time trainers. Proceedings at the First Interservice - Industry Training Equipment Conference, NAVTRAEQUIPCEN Report No. IH-316.

Zajkowski, M.M., Heidt, E.A., Corey, J.J., Mew, D.V., and Micheli, G.S. An Assessment of Individualized Instruction in Navy Technical Training. TAEG Report No. 78, Training Analysis and Evaluation Group, Orlando, FL, November 1979.